# About the Health and Safety Executive. Process Safety based on risk and performance indicators

Sobre el Ejecutivo de Salud y Seguridad. Proceso de seguridad basado en indicadores de riesgo y desempeño

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## ABSTRACT

From the perspective of risk-based safety, the risk level of the risks in the process industry is not the same and it is necessary to identify larger risks, with the approach of the various resources available in the organization, which are often finite, in an optimal and effective manner. The section will be used. Measuring and monitoring performance indicators in this strategy is very important. These indicators provide a complete picture of the usefulness and effectiveness of the safety-related activities of the process, while identifying gaps and weaknesses in the system, will provide a good guide for complementary actions in order to enhance the safety of the process. In this paper, while describing the principles of safety of the risk-based process, its elements have been introduced and 105 functional indicators, including progressive and bottom-up, have been defined for it. From the indicators defined in this research, we can select the most suitable ones and use them to improve the safety of the process industries.

**Key words:** Process safety, Risk, Safety excellence, Performance index

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**RESUMEN**

Desde la perspectiva de la seguridad basada en el riesgo, el nivel de riesgo de los riesgos en la industria de procesos no es el mismo y es necesario identificar riesgos mayores, con el enfoque de los diversos recursos disponibles en la organización, que a menudo son finitos, en general. Una forma óptima y eficaz. Se utilizará la sección. Medir y monitorear los indicadores de desempeño en esta estrategia es muy importante. Estos indicadores proporcionan una imagen completa de la utilidad y efectividad de las actividades relacionadas con la seguridad del proceso, mientras que identifican las deficiencias y las debilidades en el sistema, proporcionarán una buena guía para acciones complementarias con el fin de mejorar la seguridad del proceso. En este documento, al describir los principios de seguridad del proceso basado en el riesgo, se han introducido sus elementos y se han definido 105 indicadores funcionales, incluidos los progresivos y de abajo hacia arriba. A partir de los indicadores definidos en esta investigación, podemos seleccionar los más adecuados y usarlos para mejorar la seguridad de las industrias de procesos.


**Palabras clave:** Seguridad de procesos, Riesgo, Excelencia en seguridad, Índice de desempeño.

## Introduction

Most people use the term "risk" in their daily lives. Risk is a function of the probability of occurrence of an event in a given time period and the consequences (severity) of that occurrence. Many of the decisions made by people in everyday life are risk-based. Simple decisions such as cycling, driving, riding an aircraft, and even big decisions such as investing, buying a home, surgery, etc., are always accompanied by risk acceptance. It's safe to say that life is not risk-free, and all people will inevitably be risk aversion. Economically, the profitability and non-economic aspects of the physical or psychological consequences created for humans in the above decision-making processes are influential. According to ISO 31000, risk management consists of five stages of risk identification, risk assessment, risk assessment, risk control, monitoring and re-evaluation (International Organization for Standardization, 2009). The HSE-MS's Guide to Identifying Risks and their Impact, Risk Assessment and Risk Reduction Measures is directly mentioned (The international association of Oil & Gas Producers, 1994). The Standard for Occupational Safety and Health Management (OHSAS), a new edition of which has been renamed to ISO 45001 and scheduled to be released in 2016, identifies risk, assesses risk, and determines appropriate controls for risk from the requirements for deployment of this system (British Standard Institute, 2007). In the Environmental Management System (EMS-ISO 14001), the environmental aspects and environmental impacts that are considered as environmental risk are considered (International Organization for Standardization, 2004). The new edition of the Quality Management System Standard (QMS-ISO 9001, released in 2015) is also intended to address the issue of risk and its analysis (International Organization for Standardization, 2015). In Risk Based Inspection (RBI), unlike current inspection programs, there is no fixed and identical interval for inspection of all equipment, but each device or equipment will have its own separate inspection program.

In this method, at first, the probability and the consequences of equipment disruption (especially pressure equipment) are calculated and the risk level is obtained. Based on the amount of risk, the equipment is pre-specified and the inspection plan is defined (American Petroleum Institute, 2009). Apparatus and equipment, although well-designed and built, will not be safe unless they are well maintained and repaired. Risk-Based Risk Management (RBM) uses risk levels as a measure of repair planning and design. In this strategy, the design and decision making for the note is based on the level of risk that failure to perform the note in due time will create. In addition, the results of this method can be used to specify the resources and budget needed for the optimal performance of the process industries in the maintenance and repair department (Faisal I. Khan, Mahmoud M. Haddara, 2003) and (N.S. Arunraj, J. Maiti. 2007). Chemical safety activities, especially in the oil industry, have been taking place very far away. After several catastrophic industrial disasters (in many parts of the world), Process Safety Management (PSM) was initiated by the OSHA in the early 1990s. And in order to reduce the risk of incidents occurring in the process industries (U.S. Department of Labor, Occupational Safety and Health Administration, 1994). (U.S. Department of Labor, Occupational Safety and Health Administration, 2000) However, in many companies the incorrect performance of the organization's management system and the deficiencies in the PSM, as well as the absence of significant advances in the safety of process industries, led to a new approach is called the Risk Based Process Safety (RBPS). Figure 1 shows the center of risk in a variety of topics. This form draws the attention of industry managers and decision-makers in different areas to the importance of risk (Center for Chemical Process Safety, 2007).

Figure 1. Application of risk management in various fields


After about 15 years of implementation of PSM, the Center for Chemical Process Safety (CCPS) has been developing the RBPS in the late 2000s. Therefore, it can be said that the safety of the risk-based process has provided a framework for a new generation of process safety management. Various strategic approaches have been developed in the process industries over the past decades in the field of chemical incidents and damages. A risk-based strategy prevents unnecessary resources from being allocated to low-risk activities, thus releasing existing resources for highrisk activities. In RBPS, while identifying all hazards, it is pointed out that the risk of risks is not the same and that it is necessary to identify larger risks, this identification helps the management to use existing resources first for greater risks. Make By this way, the limited resources available in the organization are effectively and efficiently used to promote the safety of the system and increase the overall performance of the organization. Commitment and real determination, reliable and continuous on the safety of the process, is the basis and basis for the process of safety excellence. The management commitment has no substitute and this commitment should be extended throughout the organization. If there is a belief in employees that the safety of management is a real value, the willingness to do the right thing in a safe and appropriate manner will increase. This principle has five elements.

## Methodology

Organizations that understand the risks and understand the risks, resources that are usually limited in the organization, will be as effective as possible. Less risky operations have the potential to stabilize the system and prevent various stresses on process equipment and personnel. This principle has two elements. Risk management; this principle should be considered continuously and continuously. The focus of this principle is on the maintenance and prudent operation of the process, and emphasizes management of change, emergency response, and readiness in the event of various occurrences. This principle has nine elements. Learning from experiences means continuous monitoring of internal and external information in relation to events (events and events) and lessons learned from them. In this principle, feedback is based on performance indicators, events, audits, and management review. With the information obtained from the evaluation of performance indicators, sufficient reason and motivation will be created to improve the performance of the organization. This principle has four elements. According to Table 1, each of the four principles in the RBPS has the following elements as follows: As indicated in the table, the highest number of elements is included in the risk management principle, which indicates the centrality and importance of the risk category in the RBPS strategy (Center for Chemical Process Safety, 2007).

Table 1. The Four Principles and the Twenty Elements in the RBP

| | Key Principles of RBPS | RBPS elements |
|---|---|---|
| **Risk Based Process Safety** | 1. Commitment to the process safety | 1. Process safety culture |
| | | 2. Compliance with standards |
| | | 3.The adequacy and ability process safety |
| | | 4. Workforce participation |
| | | 5. Attracting stakeholders |
| | 2. Understanding the risk | 6. Process Knowledge Management |
| | | 7. Risk identification and risk analysis |
| | 3. Risk Management | 8. Procedures of Operation |
| | | 9. Safe working methods |
| | | 10. Reliability and integrity of assets |
| | | 11. Contractor Management |
| | | 12. Training and Performance |
| | | 13. Change Management |
| | | 14. operational readiness |
| | | 15. Operation guidance |
| | | 16. Emergency management |
| | 4 Learning from experiences | 17. Investigating incidents |
| | | 18. Measuring and Indicators |
| | | 19. Audit |
| | | 20. Management review and continuous improvement |

Performance indicators, which in some texts are referred to as key performance indicators (KPIs), and in some cases also metrics, (Janicak, 2005) and (Center for Chemical Process Safety, 2011), such as the dashboard, it is a car that can be prevented from undesirable events due to inadequate system operation, in addition to monitoring the system conditions instantly. Identifying indicators and monitoring them is required in order to achieve continuous improvement and also measure activities and actions against needs and objectives. By using indicators, learning from experiences and lessons learned from events is one of the principles of the RBPS. Indicators can be divided into two types of forward and follow ups as follows. Leading Indicators: The (leading indicator) indicates the effectiveness and effectiveness of operational, process, and management actions in the field of safety and shows the impact of preventive measures in the events (Center for Chemical Process Safety, 2007). These types of indicators indicate the potential issues and potentials for deteriorating conditions, thus providing justifiable reasons for carrying out preventive activities and providing resources for it. By monitoring the progress indicators, the weaknesses are identified and can be predicted and even prevented before an event with an adverse outcome occurs. Inspections, audits, certifications, safety meetings, percentage of events reviewed, pseudo-events, training, new systems or controls. Are examples of leading indicators (UK Health and Safety Executive, 2008) and (American Petroleum Institute, 2010). Lateral indicators: (lagging indicator) is like the car's rear mirror and is oriented towards the outputs or the reverser to the record. These types of indicators represent actual issues and measure the quality of the activities performed on the basis of the cases that occurred. Human casualties, lost work days, injuries, occupational diseases, material leakage, fire and explosion, dangerous energy release, warning and summoning from legal authorities, ... samples of the indicators of the recession (UK Health and Safety Executive, 2018) and (American Petroleum Institute, 2010). Generally, progressive, forward-looking indicators and backward indexes are retrospective. Identifying or categorizing indices and determining which indicators are progressive and which index is far from important. It is important that using the actual data in the organization, a combination of indicators is defined and measured and analyzed in appropriate time intervals.

## Result and discussion

In this paper, based on the experience of the process industry, 24 criteria are considered first in Table 2. Criteria are the main activities or systematic actions that are carried out in different parts of the process industry and are in some way related to the safety of the system.

Table 2. Criteria for process safety and related issues

| Criterion number | Criterion | Criterion number | Criterion | Criterion number | Criterion |
|---|---|---|---|---|---|
| 1 | Human Resources and Labor Force | 9 | Changes in process and equipment | 17 | Emergency equipment |
| 2 | Identification and analysis of process hazards | 10 | Management review sessions | 18 | Exercise and Manage Emergencies |
| 3 | Committees and safety meetings | 11 | Standards and legal requirements | 19 | Visits, inspections and safety audits |
| 4 | Record, review and report incidents | 12 | Programs and courses | 20 | Planning and development of systems |
| 5 | Technical inspection and fault reporting | 13 | Selection and evaluation of contractors | 21 | Participation system and suggestions |
| 6 | Notes, commands and job requests | 14 | Work permits in the process | 22 | Information and Documentation Process |
| 7 | Purchase of equipment, materials and materials | 15 | Public relations and communications | 23 | Corrective and Preventive action |
| 8 | Working procedures and operating instructions | 16 | An organization to review and review its process and equipment before it is put into operation | 24 | Measuring and monitoring of services and products |

After determining the above criteria, indicators should be considered as progressive and progressive. In addition, each index must have at least a similarity criterion, it should also be appropriate. The characteristics of an appropriate index are given in Table 3. In this table, six characteristics are considered in order to assess the appropriateness of an indicator (American Petroleum Institute, 2010).

Table 6. Characteristics of an appropriate indicator

| Row | Feature Indicator | Feature description |
|---|---|---|
| 1 | Reliable | Specific to any topic, it is distinct and objective. |
| 2 | Repeatable | If measured by other people, the results are the same. |
| 3 | Compatible | The measurement unit and the definitions used are consistent throughout the company. |
| 4 | Comparable | Compare with other companies or in the same industry. |
| 5 | Meaningful | Includes enough data to indicate a positive or negative change. |
| 6 | Easy | Calculating, measuring, and using it is easy for people. |

For each element of RBPS, separate indicators (total 105 indicators) are presented in Table 4 as proposed. The indexes in Table 4 are a combination of author ideas and the CCPS guideline. The definitions of these indicators have also been considered to be feasible. Using existing data in the organization and determining the relevant mathematical formulas in different software programs, it is possible to analyze these indexes and examine their trends.

Table 4. Performance indicators separate by each element

| RPBS elements | Performance Indicators for each element (proposed) |
|---|---|
| 1.Process safety culture | The percentage of planned process safety visits actually implemented. |
| 2. Compliance with standards | The number of standards that have been identified and used in relation to the safety of the process. |
| 3. Sufficiency and safety of the process | The percentage of new cases raised by employees in the process safety meetings. |
| 4. Labor force participation | Percentage of staff members involved in participatory process security activities and activities. |
| 5. Attracting stakeholders | The number of meetings and meetings held with the stakeholders of the company. |
| 6. Process knowledge management | A percentage of Material Safety Data Sheets (MSDSs) available and available to relevant staff. |
| 7. Risk Identification and Risk Analysis | The percentage of processes in which risk identification and risk analysis are fully implemented. |
| 8. Operational procedures | The percentage of operational procedures revised in a given time period. |
| 9. Safe working methods | Percentage of work permits that required controls are adequately and appropriately executed. |
| 10. Reliability and Asset Integrity | The percentage of purchases made (equipment and process equipment) that are considered to be reliable. |
| 11. Contractors Management | Percentage of contractor personnel who have been trained for safety training. |
| 12. Training and performance | A percentage of the staff involved in the process of safety education. |
| 13. Change management | Percentage of changes made without regard to the requirements for change management. |

| | |
|---|---|
| 14. Operational readiness | The number of unwanted shutdowns that occurred after the startup. |
| 15. Guiding the operation | The number of events that operational issues have been its root causes. |
| 16. Emergency management | Number of meetings held in response to Emergency Response Plans. |
| 17. Check events | A percentage of process incidents that have been investigated over a period of 48 hours. |
| 18. Measurements and indicators | The number of RBPS elements for which the index is defined and measured. |
| 19. Audits | Percentage of audits performed on a predetermined schedule. |
| 20. Management review | The number of events that RBPS elements play in. |

For each of the RBPS elements, the individual indices in Table 4 are considered as proposed. The indexes in Table 4 are a combination of author ideas and the CCPS guideline. The definitions of these indicators have also been considered to be feasible. Using existing data in the organization and determining the relevant mathematical formulas in different software programs, we can analyze these indexes and examine their trends. Criteria, actions and activities carried out in different parts of the organization. In order to determine responsibilities in these areas as well as allocate the resources they need; they should identify the position of each indicator in the predefined criteria. Indicators can be likened to a thermometer or barometer in a physician's (director or supervisor's) office, by which the process of improving the condition is monitored.

If the inadequate indicator is chosen, the organization's problems will not be identified and the goals in the RBPS will not be realized. Based on industry standards relating to quality, safety, etc., all emphasizing on the identification and assessment of the organization's risks, the establishment of risk-based process safety in integrating these standards and making optimal use of the organization's resources is very efficient. In order to carry out effective measures and also to make a realistic decision in process industries, we need to use performance indicators. Without the actual information on the safety of the process, it is not possible to improve the complex version and conditions. Performance indicators are the only tools available to examine the safety of process industries. The application of the leading indicators is in targeting and allocating resources and the use of post-graduate indicators in learning and learning from the past. The use of indicators should take into account the past and future, and the most suitable indicators in combination (forward and backward).

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